

Change in Visual Perception and Balance Caused by Different Types of Hat

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Abstract. [Purpose] This study aimed to determine the effect of the type of hat worn on balance, eye-hand coordination, and visual perception of normal adults. [Subjects and Methods] Eight healthy male (20.87 ± 1.95 years, 171.38 ± 4.03 cm, 60.75 ± 7.94 kg) and seven female (20.14 ± 0.89 years, 160.57 ± 5.25 cm, 57.14 ± 7.92 kg) university students participated in this study. Balance ability, eye-hand coordination, and visual perception were measured when subjects were bare-headed, and when they wore a hat, cap or hood. [Results] There were significant differences in balance and visual perception according to the type of hat worn, but eye-hand coordination did not change. Therefore, field of vision and visual perception changed according to the type of hat worn. [Conclusion] These results show that field of vision can be blocked, depending on the size of the hat visor, resulting in poor visual perception and consequently balance. Therefore, there are potential risks associated with wearing certain types of hat.

Key words: Balance, Hat, Visual perception

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INTRODUCTION

Hats are head coverings that vary in type and size according to their purpose. A hat can be worn both for fashion and for function, such as head protection and the blocking of ultraviolet (UV) rays. Generally, the word “hat” refers to a head covering that has a brim, the word “cap” refers to a head covering with a visor at the front, and a “hood” covers most of the head and ties with a string under the chin or around the neck¹⁾. Hats with large brims or visors are widely used for UV protection. However, these types of hats can cause interference in the delivery of visual information, because the brim sometimes blocks a part of the wearer’s field of vision²⁾.

Effective eye-hand coordination is necessary for successful performance of visual and spatial activities of daily living. When a person experiences difficulties in visual perception, his or her independence is affected as well as the ability to learn new actions, maintain upright balance, perceive space accurately, or manipulate objects³⁾. In order to catch moving objects or precisely hit moving balls, an individual must be able to predict the object’s speed and perform a motion that is spatiotemporally consistent with the moving object. Therefore, it is important to integrate the perception of visual information with a particular motion system (Fleury, 1992)⁴⁾. Visual accuracy is also criti-

cal for balance and movement; individuals with poor visual accuracy are reported to have difficulties with posture and balance⁵⁾. For a person to be able to live and function in a variety of environments, it is important to maintain specific postures and balance while performing tasks that require body movement or readjustment due to unexpected external forces⁶⁾. Balance control is a highly complicated function that involves the integration of the nervous and musculoskeletal systems. Visual, auditory, vestibular, and proprioceptor sensations, as well as visual-space perception, stimulate the central nervous system to quickly and accurately respond to environmental change to adjust muscle tone, muscle strength, endurance, and joint flexibility. Balance performance can be diminished if any of the above factors are disabled⁷⁾.

Wearing a hat, whether for fashion or function, can obstruct the wearer’s field of vision, negatively affecting visual perception, which could interfere with the individual’s activities of daily living. Therefore, in this study, we aimed to determine the effect of the type of hat worn on balance and eye-hand coordination, as well as visual perception, of normal adults.

SUBJECTS AND METHODS

This study was conducted on April 11 and 12, 2013. Subjects comprised a total of 15 students attending K University in Korea: eight adult males in their 20s (age: 20.87 ± 1.95 years, height: 171.38 ± 4.03 cm, weight: 60.75 ± 7.94 kg), and seven adult females also in their 20s (age: 20.14 ± 0.89 years, height: 160.57 ± 5.25 cm, weight: 57.14 ± 7.92 kg). In order to consistently control the amount of sunlight, which can affect visual information, direct sun-

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light was blocked out using blinds and the experiment was conducted between 4 p.m. and 6 p.m., using controlled artificial lighting to brighten the study environment. The study objectives and procedure were explained to the subjects and their consent to participation was obtained. The following criteria were used for selection of the study subjects: no problems with visual perception, such as eyesight or field of vision; no problems with sense of balance; and no problems with upper extremity function.

The following types of hats were used in this study: a hat with a large brim surrounding the crown; a cap with a brim on the front, and a hood without a brim that surrounded the neck, ears, and head. Balance, eye-hand coordination, and visual perception were measured when subjects were bare-headed, and when they wore a hat, cap, or hood. The Modified Berg Balance Scale (MBBS) was used to measure balance ability. The MBBS is a modified version of the Berg Balance Scale (BBS). BBS testing is conducted on a mat of sufficient elasticity, and measurements are made using the visual analog scale (VAS). The BBS consists of three sections: sitting, standing, and posture changes; these are divided into 14 subsections⁸⁾. The subjects of the present study were normal healthy adults, and the standard BBS did not provide sufficient discrimination, because its intended use is the assessment of elderly or hospital patients. Therefore, in the present study, we had the subjects perform motions of the BBS on an elastic Ky Bouncer (Swiss, 296×46×6 cm) mattress, which is a soft, elastic, functional mattress made of a special density material. It is typically used in rehabilitation exercises or retirement homes to improve balance and posture. The subjects' motions were evaluated using a VAS from 0 to 10, where 0 represented a motion that was difficult for a subject to perform and 10 represented a motion that was easy to perform.

The Minnesota Manual Dexterity Test (MMDT) was used to determine the subjects' eye-hand coordination when wearing the different types of hats. The MMDT consists of a thin foldable board that has 60 holes, each hole is 3.7 cm in diameter and 1.8 cm in height, and 60 red- and black-painted blocks that fit into the holes on the board. The instructions involve placing, turning, moving and placing, one-handed turning and placing, and two-handed turning and placing of the blocks into the holes. Our test was conducted with the test board placed to the front and center of each study subject on a testing table that was adjustable to 28 to 32 inches in height. In this study, the subjects performed the turning test. Each subject was allowed to practice the movements

once. Then, the test subjects' performance times were measured using a stopwatch; the times and subjects' agility of movement were recorded. High eye-hand coordination is indicated when a subject's time is shorter than the standard time⁹⁾.

The Dynavision 2000 was used to measure the average visual perception response speed of our normal healthy adult subjects. Dynavision is a wall-hanging plate (120 × 165 × 20 cm) containing 64 small square red target buttons arranged in five nested rings that light up (Klavara et al., 1995). In this study, an apparatus-paced test was conducted, in which the lights randomly lit up; if the button was not pushed within one second, the light moved to another button. In a quiet, bright indoor space, with legs shoulder-width apart, the subject was positioned 30 cm away from the edge of the light in front of the Dynavision board. The LED window at the center of the Dynavision board was aligned with the eyes of the subject. The buttons at the outer side, uppermost and lowermost sections of the board could be easily reached by the subject. Both hands could be used during the test. Subjects were allowed a single practice session to familiarize themselves with the use of the Dynavision. Numbers (5, 4, 3, 2, 1, and 0) appear in the LED window and a verbal signal ("Start") was given as soon as the countdown reached 0.

Data were analyzed using the SPSS (version 18.0) statistical analysis program. Statistical analysis was conducted to determine the general characteristics of the subjects' actions. One-way ANOVA was conducted to analyze balance, eye-hand coordination, and visual perception. Scheffe's method was used for post hoc analysis. Significance was accepted for values of $p < 0.05$.

RESULTS

The results of the balance measurements according to the type of hat are as follows: bare-headed without hat (8.20 ± 1.93), hood (6.67 ± 2.09), cap (6.27 ± 1.83), and hat (5.33 ± 2.47), with statistically significant differences ($p < 0.01$). Therefore, balance ability changed depending on the type of hat worn (Table 1).

The results of the eye-hand coordination measurements according to the type of hat worn are as follows: bare-headed without hat (85.96 ± 14.15), hood (89.38 ± 16.21), baseball cap (91.83 ± 14.50), and hat (95.70 ± 15.69); these results are not significantly different? Therefore, eye-hand coordination did not change according to the type of hat worn (Table 1).

Table 1. Comparison of balance, eye-hand coordination and visual perception

Type of hat	N	BBS**	MMDT	DYNA**
		M±SD		
without hat ⁴	15	8.20±1.93 point	85.96±14.15 second	63.86±9.45 piece
Hood ³		6.67±2.09 point	89.38±16.21 second	60.80±9.65 piece
Cap ²		6.27±1.83 point	91.83±14.50 second	56.93±7.06 piece
Hat ¹		5.33±2.47 point	95.70±15.69 second	52.73±6.63 piece
Scheffe		1>2	-	1>2

** $p < 0.01$

The results of the field of vision and visual perception measurements according to the type of hat are as follows: bare-headed without hat (63.86 ± 9.45), hood (60.80 ± 9.65), baseball cap (56.93 ± 7.06), and hat (52.73 ± 6.63); these results are statistically significant ($p < 0.01$). Therefore, field of vision and visual perception changed according to the type of hat worn (Table 1).

DISCUSSION

In this study, we aimed to determine differences in balance, eye-hand coordination, and visual perception according to the type of hat worn by an individual. The comparison of the results of balance and visual perception, in this study, showed that wearing the different types of hats lowered balance ability and visual perception compared to not wearing any type of hat. In particular, balance and visual perception were lower in the following order: hat, cap, and hood. These results are similar to the results of Donan et al. (1978)¹⁰, who reported that obscuring vision? affected posture, balance, and visual perception. We consider the reason for the decline in balance ability, in the order of hat, cap, and hood, is the size or location of the brim. Lack of visual input caused difficulties with exercises that required correct direction of the upper extremities. People with central visual field loss often fixate with eccentric retinas, which results in decreased visual function and compromised saccadic control, suggesting that exploratory behavior may be affected¹¹. The vision system is primarily involved in planning locomotion and guiding us in the avoidance of obstacles (i.e., balance and postural control when standing and walking)¹². Spontaneous dynamic balance is used to enhance the sensitivity of the body's stability to visual input. Visual conflicts can have powerful effects on balance. Moving visual environments can cause postural changes, disequilibrium, and motion sickness in healthy adults (i.e.,

visual influences on balance)¹³. Therefore, it can be concluded that the larger the brim size of a hat, the greater the disturbance of visual perception, increasing the possibility of imbalance and risks of fall. Patients or elderly individuals who lose their balance easily should be aware of this potential when deciding what type of hat to wear.

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